2020 Stevens Creek Fisheries Monitoring

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Reports included:

2020 Juvenile *Oncorhynchus mykiss* Rearing Monitoring in Stevens Creek

2020 Stevens Creek Juvenile *Oncorhynchus mykiss* Fish Condition

2020 Juvenile *Oncorhynchus mykiss* Rearing Monitoring in Stevens Creek



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Executive Summary

Beginning in 2020, Valley Water performed index reach monitoring for juvenile *Oncorhynchus mykiss* in Stevens Creek to document the abundance, distribution, and densities of *O. mykiss*, as well as the composition of other fish species. The Stevens Creek juvenile rearing monitoring is part of a larger effort to assess and monitor the trends of *O. mykiss* populations throughout Santa Clara County. Similar sampling began in the Guadalupe River Watershed in 2018-2019, and the Coyote Creek Watershed in 2019-2020. In 2018 the National Marine Fisheries Service and California Department of Fish and Wildlife authorized the monitoring of Stevens Creek under Section 10(a)1(A) Recovery Permit #16417-2R and Scientific Collecting Permit #11325, respectively.

In fall 2020, sampling was conducted at six stations in Stevens Creek. All species collected in Stevens Creek were native to the system and included the following: three-spined stickleback (*Gasterosteus aculeatus)*, California roach (*Hesperoleucus symmetricus),* Sacramento sucker (*Catostomus occidentalis),* and *O. mykiss*. Juvenile *O. mykiss* were found at all sampling sites with distributions skewed lower in the system. Forty-seven juvenile *O. mykiss* (0.2 *fish*/m) were captured during the sampling effort and appropriately sized individuals (≥65 mm) received PIT tags so that their movement within Stevens Creek could be monitored. The size range of *O. mykiss* collected indicated production and successful summer rearing occurred and that Stevens Creek supports multiple age classes.

2020 marked the first year of juvenile rearing monitoring in Stevens Creek and will serve as the baseline for continued efforts to better understand *O. mykiss* distribution and abundance in Stevens Creek. Since this is the first year of monitoring it is difficult to assess any trends at this time, but as more data becomes available in the following years a better understanding of *O. mykiss* populations and species composition in Stevens Creek will develop.

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Appendices

Appendix A: 2020 Stevens Creek Stream Temperature Monitoring

1. Introduction

Stevens Creek consists of approximately 32 kilometers of channel and originates in the Monte Bello Open Space Preserve in the Santa Cruz Mountains. The western portion of the watershed where Stevens Creek originates remains relatively free of anthropogenic disturbance. The creek flows southeasterly through the Stevens Creek County Park before entering Stevens Creek Reservoir, then continues north and empties into the San Francisco Bay at the Whisman Slough next to Mountain View's Shoreline Park. The eastern and northern potions of Stevens Creek flow across the Santa Clara County Valley floor, traversing mainly urbanized areas with patches of undeveloped park land. Stevens Creek drains a watershed of roughly 75 square kilometers.

Stevens Creek supports the federally threatened Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*) Distinct Population Segment (DPS) and is designated critical habitat from the creek's confluence with the San Francisco Bay to Stevens Creek Reservoir (70 FR 52570, September 2005).

In an attempt to better understand *O. mykiss* populations within this system, Valley Water biologists performed index reach monitoring for juvenile *O. mykiss* on Stevens Creek using multi-pass depletion backpack electrofishing. The goal of the sampling was to document the abundance, distribution, and densities of *O. mykiss* in the system, as well as the composition of other fish species. Genetic information on *O. mykiss* was also collected and a tracking study was implemented for juvenile *O. mykiss* using Passive Integrated Transponder (PIT) tags. These efforts will help inform the success of the Valley Water Fisheries and Aquatic Habitat Collaborative Effort (FAHCE), which seeks to improve aquatic spawning and rearing habitat and fish passage in the Guadalupe River, Coyote Creek, and Stevens Creek.

2. Methods

2.1 Station Selection

A total of six stations within Stevens Creek were sampled during October 2020. Stations were selected using stratified random sampling as well as by selecting areas of interest. Site selection was limited to locations that provided access either through Valley Water ownership, Valley Water easement, or locations owned by other governmental agencies.

The area of study for Stevens Creek was defined as the extent between Homestead Road and the base of the Stevens Creek Reservoir Dam. This area was chosen as it typically has perennial flow in most years and is the area where juvenile *O. mykiss* rearing is expected to occur. This study area was broken into six 1 km reaches, and a single station was placed within each of the six reaches. Each 1 km reach was then broken into twenty-five 40 m reaches, and a site was randomly selected using a random number generator (for stations SC001, SC002, SC003, SC005, and SC006,). The site was then selected as near to the random point as possible where at least two distinct habitat types (Ode 2007) could be included in each station. If a randomly selected site fell in an area that was infeasible to sample (e.g., too deep to effectively electrofish, safety concerns, etc.) or there was no access to the site, the station was moved to the nearest location where sampling and access would be possible. Sites SC001 and SC002 were moved 500 m upstream and 300 m downstream, respectively, from their randomly selected points to the nearest suitable sampling locations due to limited access. SC004 was chosen as an area of interest for long-term monitoring as it is a Valley Water Stream Monitoring Program (SMP) restoration site which has undergone large woody debris installation. The final results of the Stevens Creek sampling station selection can be seen in Figure 1. Valley Water also initiated stream temperature monitoring within the study area and in other sections of the anadromous portion of Stevens Creek in 2020. Details regarding stream temperature monitoring are provided in Appendix A.

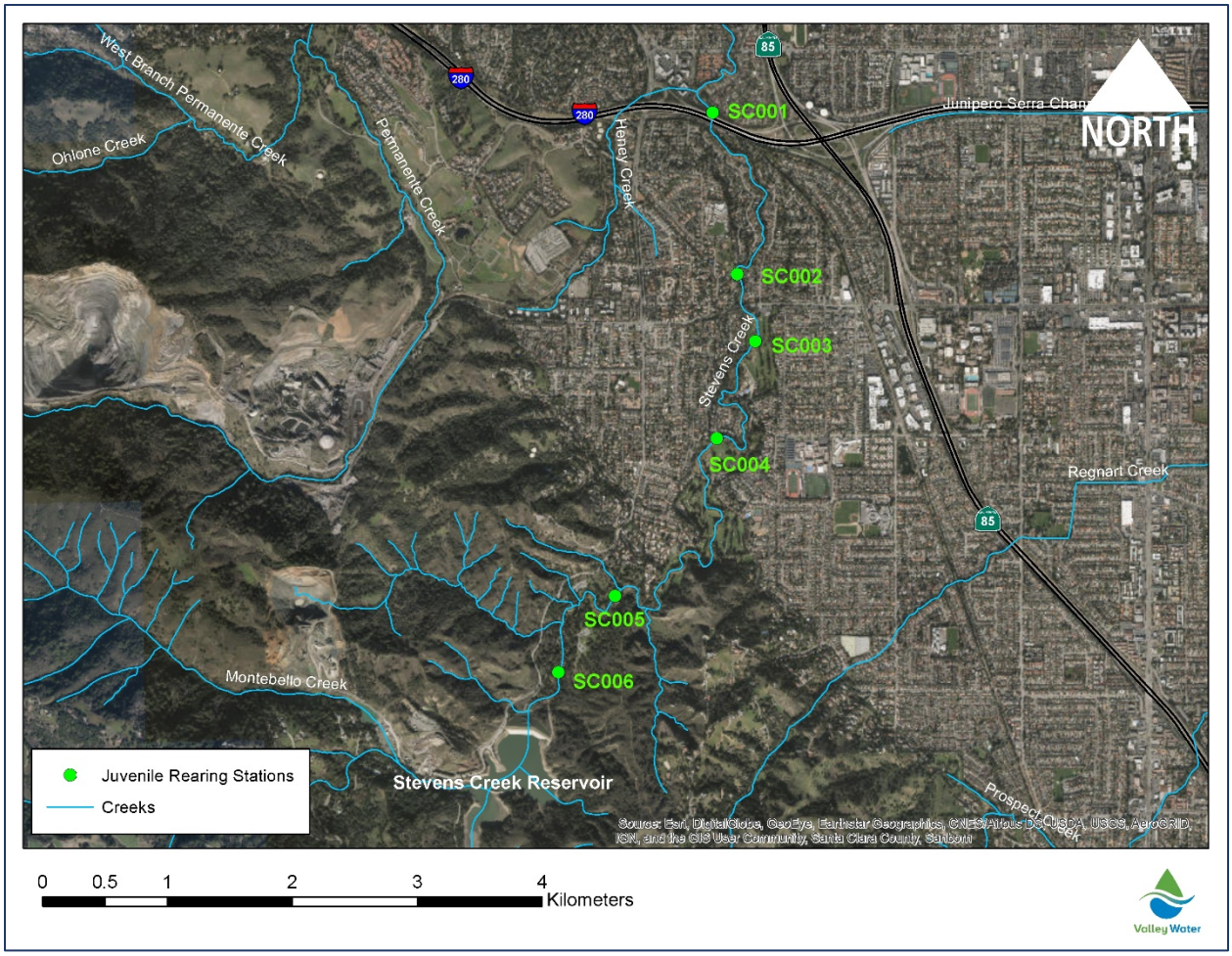


Figure 1. Stevens Creek juvenile rearing monitoring stations.

2.2 Sampling Methods

Each monitoring station was between 30 and 40 meters in length. The target length was 40 meters, but slight deviations occurred due to environmental constraints prohibiting the ability to install and secure block nets to cordon off the sampling reach or to avoid areas were electrofishing could not be effectively conducted. At least two distinct habitat types were included in each station. Multi-pass depletion backpack electrofishing (Johnson et al. 2007) was conducted at every station on October 28 and 29, 2020. These methods allowed for consistency with other juvenile rearing monitoring efforts within the area, the extrapolation of population estimates, and the sampling of a variety of habitat types.

Habitat Typing

Each sampling station was habitat-typed using the following habitat units: cascade, fall, rapid, riffle, run, step-run, glide, or pool (Ode 2007; Table 1). Habitat typing was ultimately left to the discretion of the principal investigator, with Ode (2007) serving as a guideline. Average wetted width and depth was estimated based on 3 points within the reach (upstream, downstream, and mid-reach). The presence of any anthropogenic influences (bridge, dam, etc.) was noted. Prior to the start of sampling, ambient weather conditions were recorded and water quality data (dissolved oxygen, conductivity, and temperature) were collected at the upstream end of each monitoring station.

Ocular estimates were recorded on macrophytes/emergent vegetation, boulders, woody debris, undercut banks, overhanging vegetation, root wads, and artificial structures. These estimates were based on percent coverage within the sampling reach, and each habitat feature was recorded on a 0 to 4 point scale with 0 being absent and 4 being very heavy presence (Table 2). Primary and secondary substrate types were determined based upon ocular estimates (Ode 2007; Table 3).

Table 1. Habitat type classifications (Ode 2007).

Habitat Type	Description
Cascades	Short, high gradient drop in streambed elevation often accompanied by boulders and considerable turbulence.
Falls	High gradient drop in elevation of the streambed associated with an abrupt change in the bedrock.
Rapids	Sections of stream with swiftly flowing water and considerable surface turbulence. Rapids tend to have larger substrate sizes than riffles.
Riffles	Shallow sections where the water flows over coarse streambed particles that create mild to moderate surface turbulence.
Step-Run	A series of runs that are separated by short riffles or flow obstructions that cause discontinuous breaks in slope.
Runs	Sections without flow obstructions. The stream bed is typically even and the water flows faster than it does in a pool.
Glides	A section of stream with little or no turbulence, but faster velocity than pools.
Pool	A reach of stream that is characterized by deep, low-velocity water and a smooth surface.

Table 2. Ocular estimate scale (Ode 2007).

Scale	0	1	2	3	4
Percent Coverage	0%	<10%	10-40%	40-75%	>75%
Descriptor	Absent	Sparse	Moderate	Heavy	Very Heavy

Table 3. Substrate classes (Ode 2007).

Particle Size	Size Category
Boulder	> 250 mm
Cobble	64-250 mm
Gravel	2.0-64 mm
Sand	<2.0 mm (gritty texture)
Silt/Clay	Not gritty
Bedrock	No individual particles

Electrofishing

Block nets were deployed at the upstream and downstream ends of the sampling reaches to prevent immigration and emigration between sampling reaches and the rest of the channel. Block nets were secured with rebar and spreaders to hold the nets in place and keep the top above water, and large rocks were used to add extra security to the lead line and keep the bottom of the net flush with the channel bottom. Smith-Root LR24 Backpack Electrofishing Units were used at all sampling sites. Electrofishing was conducted from downstream to upstream throughout each reach. Only one LR24 backpack electrofisher was used at each sampling event as the channel width never exceeded 7 m (Johnson et. al 2007). The electrofisher operator was flanked by two netters. Verbal communication and spatial awareness were used to ensure the entire width of the stream was covered. Fish captured were held in dark colored 5-gallon buckets or live cars during each electrofishing pass. Fish were held in aerated 5-gallon buckets during processing (described below). All fish were held in a live car outside of the sampling reach and outside of the field of current from the electrofisher in an area with flow and adequate shade from the time processing ended until the sampling event was complete to allow fish time to recover and to prevent processed fish from re-entering the sample reach. All fish were released after the final pass.

Due to the nature of multi-pass depletion sampling, assumptions were made in order to interpret the data. At all sites, it was assumed that no emigration or immigration

occurred due to the implementation of block nets, shocking efficiency did not change between passes, staff did not become more efficient using the equipment, and fish did not learn to avoid the electrical field between passes.

Fish Processing

Fish were held in aerated, dark-colored 5-gallon buckets during processing. Lengths were recorded to the nearest millimeter at the fork of the tail (fork-length). Weights were recorded for *O. mykiss* to the nearest tenth of a gram using an Ohaus NVT22001. For each pass with the electrofisher, up to 30 individuals of each species were measured, and all other individuals of that species were tallied for a total number. All *O. mykiss* were measured regardless of number caught in a pass.

Carbon dioxide (CO_2) was administered to *O. mykiss* individuals via Alka-Seltzer Gold tablets placed in a bucket with stream water in doses to induce light narcosis (1 tablet per 2.5 liters of stream water). *O. mykiss* were exposed to the anesthesia for no more than 5 minutes. *O. mykiss* were observed for listing, and upon listing were removed from the anesthetizing solution, scanned to determine if a PIT tag was present, weighed, measured, tail-clipped for a genetic sample, and PIT tagged if large enough (≥65 mm fork-length) and not previously tagged. After all procedures were completed, fish were returned to an aerated, dark-colored 5-gallon bucket to recover, before being moved to an in-channel live car for full recovery before being released back into the channel at the end of the sampling event.

Fin clips were taken for genetic analysis on all *O. mykiss* from the caudal fin. Clips were 1-2 mm^2. Medical grade scissors used to collect genetic samples were sterilized between each use with an alcohol dilution, with a final concentration of at least 60-80% isopropyl. Tissue samples were placed in sterile chromatography paper and then placed in a labeled envelope denoting the field specimen number, species, stream, sample reach ID, date, and fork-length. Tissues collected will be sent to the National Marine Fisheries Service (NMFS) Southwest Fisheries Science Center for analysis after an adequate sample size has been obtained.

All PIT tagging was conducted in accordance with the PIT Tag Marking Procedures Manual (CBFWA 1999) by staff trained in the procedure. All *O. mykiss* of 65 mm in fork-length or greater, which had not been previously tagged, received a PIT tag. Biomark single-use, preloaded needles were used in the tagging process. *O. mykiss* greater than or equal to 65 mm to 149 mm fork-length received 12 mm half-duplex PIT tags. *O. mykiss* 150 mm fork-length or greater received 23 mm tags. The permits allow for fish greater than 100 mm to be tagged with 23 mm tags, but to be conservative of the fishes' welfare Valley Water increased the minimum size for a 23 mm tag to 150 mm.

2.3 Data Analysis

MicroFish 3.0 was used to calculate population estimates for each station using a maximum likelihood iterative process (MLIP); the associated standard errors and 95% confidence intervals (CI) are reported. This method uses the number of fish captured (n) and the difference in capture between each subsequent electrofishing pass (i.e., depletion rate) to calculate an estimate of fish likely to have been present but not captured, thus generating a population estimate (N) for each station. Population estimates are restricted to the sampled areas and are only an index of the overall population. If the number of individuals of a particular species was too low (i.e., only one fish captured) or all fish of a particular species were captured on the first pass (i.e., fish of a given species were captured on the first pass, with no individuals of that species captured on subsequent passes), then a maximum likelihood population estimate could not be estimated. If the lower confidence interval was less than the total catch it was set equal to the total catch, as it is certain at least that many fish were present in the sampling reach. These calculations assume no emigration or immigration occurred across the duration of sampling, shocking efficiency did not change between passes, staff did not become more efficient using the equipment, and fish did not learn to avoid the electrical field between passes.

3. Results and Discussion

Sampling occurred at six stations on Stevens Creek on October 28 and 29, 2020. The weather was sunny and clear with no precipitation. Flows at the ALERT 5044 stream flow gage on Stevens Creek below Stevens Creek Reservoir were approximately 3 cubic feet per second (cfs; flow measurements will be reported used the standard unit system) during all sampling days.

SC001

SC001 was the most downstream station sampled on Stevens Creek. SC001 was low gradient and located directly upstream of Highway 280. A dense riparian corridor was present, but the west bank of the channel abuts residential properties. The monitoring station was 40 m in length with an average wetted width of 5 m and an average depth of 0.2 m (Figure 2). Three habitat types were present within the station: glide, riffle, and run. The glide made of 75% of the habitat sampled, the riffle made up 20%, and the run made up 5%. The primary substrate was cobble and the secondary substrate was silt. Water quality and habitat complexity at the time of sampling are summarized in Table 4.



Figure 2. Photos of station SC001, looking upstream (left) and downstream (right).

Table 4.SC001 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
613.00	14.1	10.11	64.9

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
2	0	0	0	3	1	0

Fish captured and associated population estimates are summarized in Table 5. Four fish species were captured at this site: three-spined stickleback (*Gasterosteus aculeatus)*, California roach (*Hesperoleucus symmetricus),* Sacramento sucker (*Catostomus occidentalis)* and *O. mykiss*. The most abundant species was California roach. The MLIP indicates that the number of *O. mykiss* and three-spined stickleback present in the stream were likely higher than observed.

Table 5. Number of fish captured and population estimates at SC001.

Species	Native	n	N	SE	95% CI
California roach	Yes	10	10	0.86	10-12
O. mykiss	Yes	3	5	9.68	3-32
Sacramento sucker	Yes	5	5	1.19	5-8
Three-spined stickleback	Yes	35	127	210.25	35-543

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

SC002

Station SC002 was located downstream of Stevens Creek Boulevard and Blackberry Farm golf course. It was bordered by residential properties the east bank and a swath of undeveloped land on the west bank. A moderately dense riparian corridor was present. The monitoring station was 40 m in length with an average wetted width of 2 m and an average depth of 0.25 m (Figure 3). Three habitat types were present: rifle, run, and glide. The riffle made up 62% of the habitat, the run made up 25% of the habitat, and the glide made up the remaining 13% of habitat. The primary substrate was cobble and

the secondary substrate was silt. Water quality and habitat complexity are summarized in Table 6.



Figure 3. Photos of Station SC002, looking upstream (left) and downstream (right).

Table 6. SC002 water quality data and ocular estimates of habitat complexity.

Water Quality						
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**			
614.00	13.7	11.51	75.2			
Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
2	0	0	1	3	2	1

Fish captured and associated population estimates are summarized in Table 7. Four fish species were captured at this site: Three-spined stickleback, California roach, Sacramento sucker, and *O. mykiss*. The most abundant species was California roach. The MLIP indicates that the number of California roach, *O. mykiss*, and three-spined stickleback present in the stream at the time of sampling were likely higher than observed.

Table 7. Number of fish captured and population estimates at SC002.

Species	Native	n	N	SE	95% CI
California roach	Yes	36	40	4.10	36-48
O. mykiss	Yes	16	31	28.72	16-90
Sacramento sucker	Yes	17	17	0.53	17-18
Three-spined stickleback	Yes	10	15	0.00	15-15

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

SC003

SC003 was located adjacent to the Blackberry Farm golf course south of Stevens Creek Boulevard. Park lands bordered the station with a walking trail on the west bank. The site had minimal riparian vegetation but adequate coverage from mature trees in the area. The monitoring station was 40 m in length with an average wetted width of 3 m and an average depth of 0.4 m (Figure 4). Three habitat types were present: riffle, run, and glide. The riffle composed 20% of the habitat, the run composed 55% of the habitat, and the glide composed the remaining 25% of the habitat. The primary substrate was gravel and the secondary substrate was silt. Water quality and habitat complexity are summarized in Table 8.



Figure 4. Photos of Station SC003, looking upstream (left) and downstream (right).

Table 8. SC003 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
619.00	13.40	10.15	84.00

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
0	0	1	1	4	1	0

Fish captured and associated population estimates are summarized in Table 9. Four fish species were captured at this site: Three-spined stickleback, California roach, Sacramento sucker, and *O. mykiss*. The most abundant species was California roach. The MLIP indicates that only the number of *O. mykiss* present in the stream at the time of sampling was likely higher than observed.

Table 9. Number of fish captured and population estimates at SC003.

Species	Native	n	N	SE	95% CI
California roach	Yes	13	13	1.09	13-15
O. mykiss	Yes	12	19	13.53	12-47
Sacramento sucker	Yes	11	11	0.79	11-13
Three-spined stickleback	Yes	2	2	1.04	2-15

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

SC004

SC004 was located at one of the Stream Maintenance Program's (SMP's) restoration sites, at the McClellan Ranch Preserve. It had a robust riparian corridor and woody debris installments in the river channel. The monitoring station was 40 m in length with an average wetted width of 2.5 m and an average depth of 0.3 m (Figure 5). There were two habitat types present: riffle and run. The run made up the majority of habitat at 80% and the riffle made up the remaining 20% of habitat. The primary substrate was cobble and the secondary substrate was silt. Water quality and habitat complexity are summarized in Table 10.



Figure 5. Photos of Station SC004, looking upstream (left) and downstream (right).

Table 10.SC004 water quality data and ocular estimates of habitat complexity.

Water Quality						
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**			
605.00	14.39	9.6	85.8			
Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
2	0	1	0	2	0	0

Fish captured and associated population estimates are summarized in Table 11. Four fish species were captured at this site: Three-spined stickleback, California roach, Sacramento sucker, and *O. mykiss*. The most abundant species was California roach. The MLIP indicates that the number of California roach and three-spined stickleback present in the stream at the time of sampling were likely higher than observed.

Table 11. Number of fish captured and population estimates at SC004.

Species	Native	n	N	SE	95% CI
California roach	Yes	12	16	7.13	12-31
O. mykiss	Yes	7	7	1.20	7-10
Sacramento sucker	Yes	15	15	1.15	15-17
Three-spined stickleback	Yes	7	8	2.99	7-15

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

SC005

Station SC005 was located in Stevens Creek County Park and was surrounded by rural park lands. A dense riparian corridor was present with thick canopy cover. The monitoring station was 40 m in length with an average wetted width of 2 m and an average depth of 0.6m (Figure 6). Three habitat types were present: riffle, run, and pool. The riffle habitat made up 25% of the habitat, the run made up 37%, and the pool made up 38% of the habitat. The primary substrate was cobble and the secondary substrate was silt. Water quality and habitat complexity are summarized in Table 12.



Figure 6. Photos of Station SC005, looking upstream (left) and downstream (right).

Table 12. SC005 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
606.00	15.76	9.6	150.0

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
0	1	0	2	3	2	0

Fish captured and associated population estimates are summarized in Table 13. Three fish species were captured at this site: California roach, Sacramento sucker, and *O. mykiss*. The MLIP indicates that the number of California roach present in the stream at the time of sampling was likely higher than observed.

Table 13. Number of fish captured and population estimates at station SC005.

Species	Native	n	N	SE	95% CI
California roach	Yes	5	6	3.57	5-15
O. mykiss	Yes	5	5	1.19	5-8
Sacramento sucker	Yes	5	5	0.44	5-6

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

SC006

Station SC006 was the most upstream station sampled on Stevens Creek. It was located within Stevens Creek County Park just downstream of the Stevens Creek Reservoir. It had a dense riparian corridor and was heavily shaded. The monitoring station was 40 m in length, had an average wetted width of 2.5 m, and an average depth of 0.3 m (Figure 7). Four habitat types were present: riffle, run, glide, and pool. The habitat was 13% riffle, 25% run, 25% glide, and 37% pool. The primary substrate was cobble and the secondary substrate was silt. Water quality and habitat complexity are summarized in Table 14.



Figure 7. Photos of Station SC006, looking upstream (left) and downstream (right).

Table 14.SC006 water quality data and ocular estimates of habitat complexity.

Water Quality						
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**			
607.00	16.97	8.39	157.0			
Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
0	1	0	2	2	2	0

Fish captured and associated population estimates are summarized in Table 15. Three fish species were captured at this site: California roach, Sacramento sucker, and *O. mykiss*. The most abundant species caught was Sacramento sucker. The MLIP indicates that the number of *O. mykiss* present in the stream at the time of sampling was likely higher than observed.

Table 15. Number of fish captured and population estimates at station SC006.

Species	Native	n	N	SE	95% CI
California roach	Yes	4	4	0.21	4-5
O. mykiss	Yes	4	6	0.00	6-6
Sacramento sucker	Yes	6	6	0.67	6-8

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

General Discussion

Based on the results of the water year (WY) 2020 sampling we can conclude that Stevens Creek supports multiple age classes of *O. mykiss* and that summer rearing in 2020 was successful. Forty-seven *O. mykiss* were collected on Stevens Creek in 2020; however, the MLIP analysis indicates that the number of *O. mykiss* could have been as high as 73 individuals within the total area sampled. Station SC002 yielded the greatest number (n=16) of *O. mykiss* and station SC001 yielded the fewest (n=3) (Figure 8). The average *O. mykiss* density (fish/meter) for all monitoring stations on Stevens Creek was 0.2 fish/meter (based on the number of fish caught [n]). The MLIP indicates that the density of *O. mykiss* on Stevens Creek was likely higher than what was observed during the sampling effort (0.3 *O. mykiss*/m). The physical habitat conditions present at all sites sampled on Stevens Creek were suitable for *O. mykiss*, but turbidity was elevated. The middle reaches of Stevens Creek typically dry during the summer which could be altering the distribution of *O. mykiss* but the dry back occurs below the sampling reaches and Stevens Creek Reservoir is the upstream boundary of anadromy.

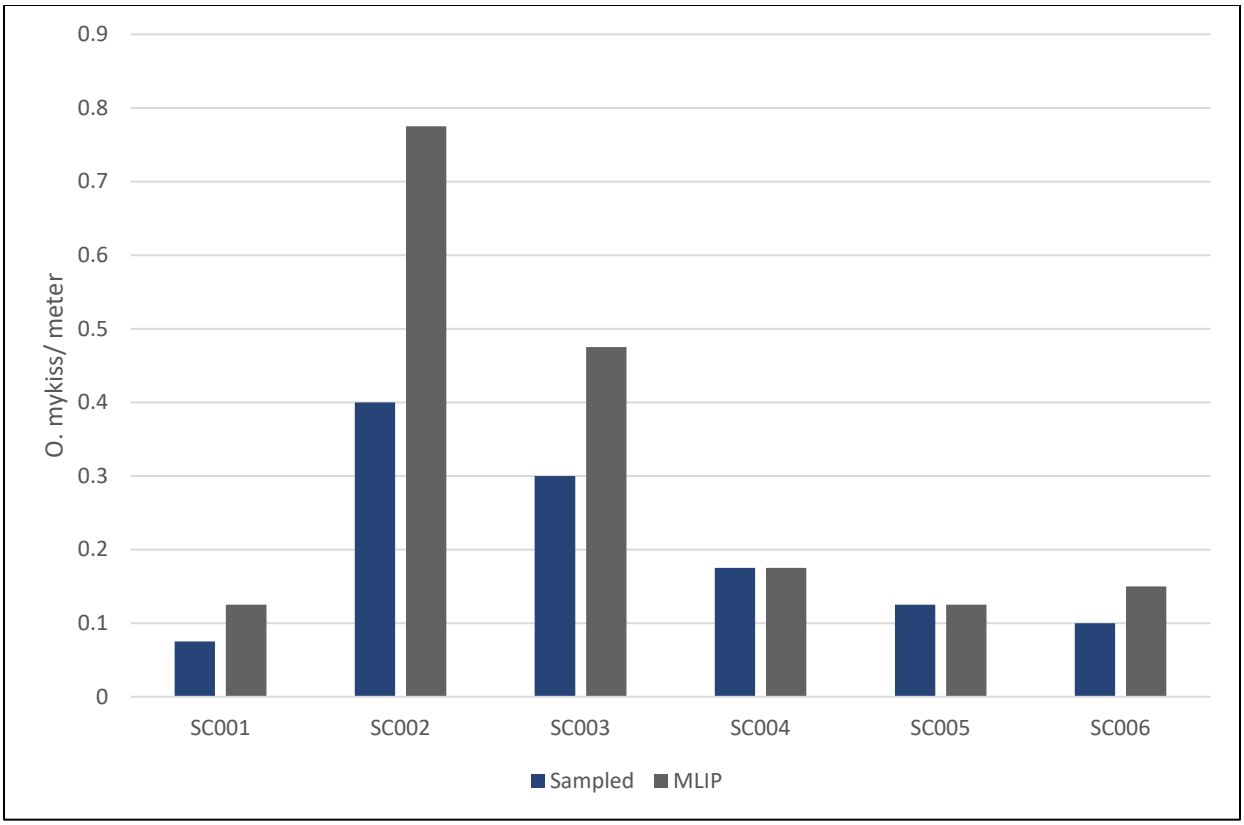


Figure 8. Density of *O. mykiss* captured compared to MLIP estimates of *O. mykiss* at each station on Stevens Creek. *O. mykiss* were present at all sites sampled.

O. mykiss caught on Stevens Creek ranged from 56 mm to 162 mm in fork-length (Figure 9). Growth rates of juvenile *O. mykiss* vary depending on temperature, food availability, stream flow, and competition. According to Moyle (2002), in small streams with low summer flows, such as Stevens Creek, young-of-the-year (YOY) steelhead measure 50 to 90 mm, and fish at the end of their second year measure 100 to 160 mm. Applying the growth rates proposed by Moyle (2002), it can be concluded that the majority of *O. mykiss* were YOY, but yearlings and potentially fish at the end of their third year were also present. The median fork-length of *O. mykiss* captured was 69 mm. On average, fork-length increased as stations got closer to the reservoir (further upstream,) but comparisons between stations could not adequately be made as the sample sizes at each station were so variable (Figure 10).

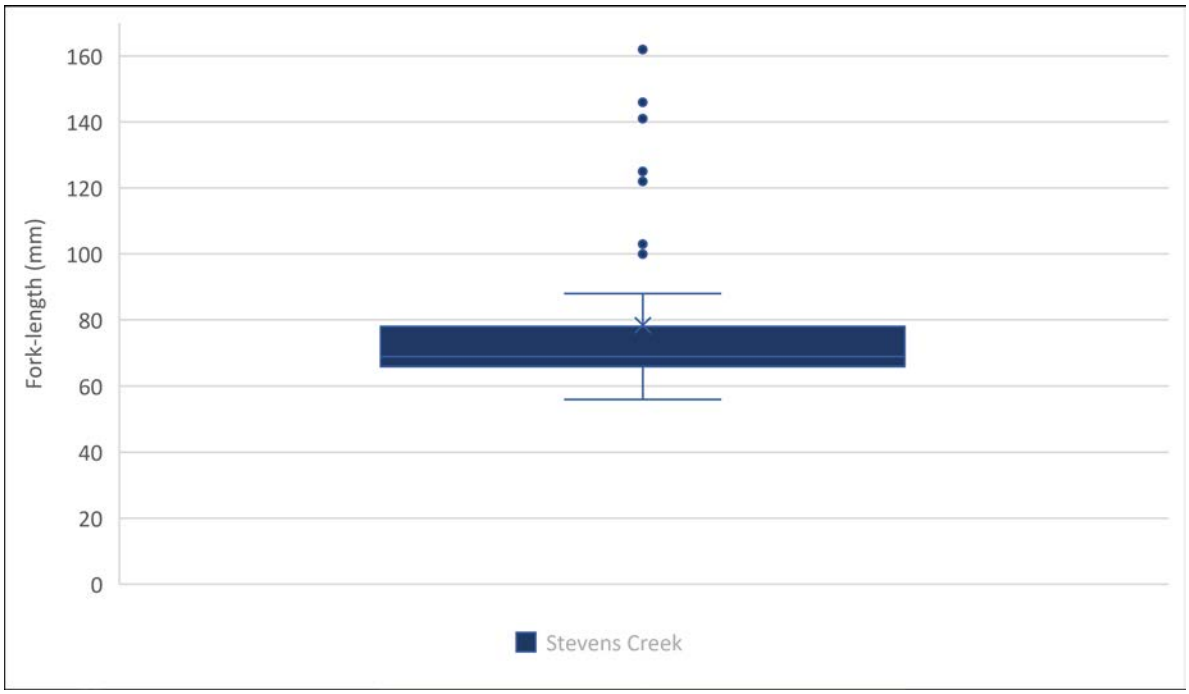


Figure 9. Distribution of fork-length of *O. mykiss* across all six sampling stations. Fork-length ranged from 56 mm to 162 mm.

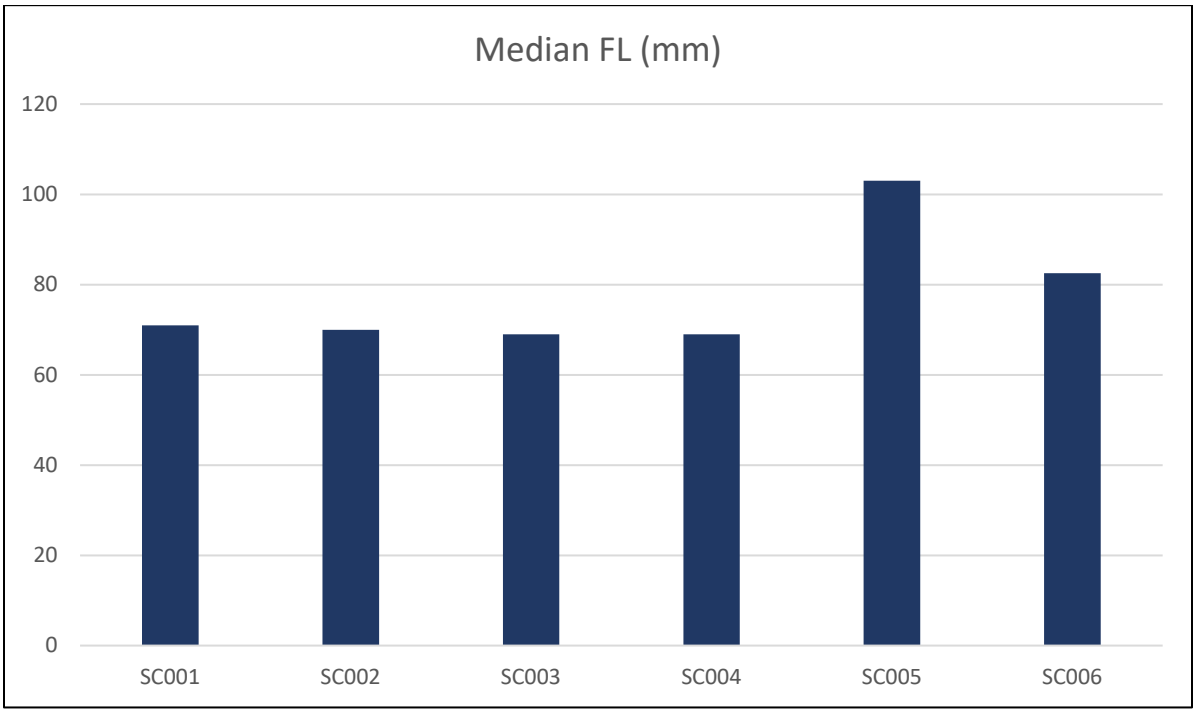


Figure 10. Median fork-length of *O. mykiss* by sampling station. SC001 is the most downstream while station SC006 is the most upstream.

All stations sampled had some amount of habitat complexity in the form of undercut banks, large woody debris, rootwads, emergent vegetation, boulders, or some combination thereof that could be used as refugia for *O. mykiss* . Riffle habitat capable of supporting fast-water feeding was present at all sampling stations.

Four species of native fish were observed on Stevens Creek and no non-native species were captured or observed during the multi-pass depletion electrofishing at the six selected monitoring stations. No *O. mykiss* sampled on Stevens Creek had the Neascus spp. parasitic infection, commonly called “black spot” disease.

4. Conclusion

Juvenile *O. mykiss* were found at all sampling stations on Stevens Creek in the fall of 2020 with higher densities skewed towards the downstream stations. The average density of fish per meter was 0.2 *O*. *mykiss*/m and the median fork-length was 69 mm. Based on the size distribution, it appears that Stevens Creek supports multiple age classes. Applying the growth rates proposed by Moyle (2002) to Stevens Creek, the majority of the fish caught were likely water year 2020 YOY, with the remaining fish likely to be yearlings from WY 2019 and potentially one or more fish at the end of their third year from WY 2018.

Physical habitat in Stevens Creek is capable of supporting the rearing and persistence of juvenile *O. mykiss* in addition to other fish species native to the system. *O. mykiss* showed no evidence of blackspot disease or other maladies and were overall in healthy condition.

This was the first year of surveys conducted by Valley Water under FAHCE on Stevens Creek, and as such it is difficult to assess any trends at this time. As sampling efforts continue in the following years and more data becomes available, a better understanding of the Stevens Creek *O. mykiss* population will develop.

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Appendix A

2020 Stevens Creek Stream Temperature Monitoring

2020

Stevens Creek
Stream Temperature Monitoring

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February 2021

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Introduction

Stevens Creek consists of approximately 32 kilometers of channel and originates in the Monte Bello Open Space Preserve in the Santa Cruz Mountains. The western portion of the watershed where Stevens Creek originates remains relatively free of anthropogenic disturbance. The creek flows southeasterly through the Stevens Creek County Park before entering Stevens Creek Reservoir, then continues north and empties into the San Francisco Bay at the Whisman Slough next to Mountain View's Shoreline Park. The eastern and northern potions of Stevens Creek flow across the Santa Clara County Valley floor, traversing mainly urbanized areas with patches of undeveloped park land. Stevens Creek drains a watershed of roughly 75 square kilometers.

Stevens Creek supports the federally threatened Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*, *O. mykiss*) Distinct Population Segment (DPS) and is designated critical habitat from the creek's confluence with the San Francisco Bay to Stevens Creek Reservoir (70 FR 52570, September 2005).

Stream temperature is an important factor affecting the abundance and distribution of *O. mykiss.* To provide continuous monitoring of temperature conditions and help assess *O. mykiss* habitat suitability within Stevens Creek, Valley Water initiated stream temperature monitoring throughout the designated habitat portion of the system in July 2020. This report summarizes the data for Water Year 2020 which ends on September 30, 2020; therefore, only summer temperature data is reported. As year-round temperature monitoring continues in Stevens Creek, it will provide valuable insights into evaluating long-term trends in the system, assessing the effectiveness of potential restoration projects, and informing management objectives.

Methods

Monitoring Stations

To provide spatial coverage of the anadromous portion of Stevens Creek (the same portion that is designated critical habitat for *O. mykiss*), stream temperatures were

monitored at six points of interest (POI) between the creek's confluence with the San Francisco Bay and Stevens Creek Reservoir (Figure 1). Stations STEV6, STEV5, and STEV4 are within the Stevens Creek cold water management zone and typically stay perennial wetted throughout the year. This area is where juvenile *O. mykiss* rearing is expected to occur. Stations STEV3, STEV2, and STEV1 experience variable flow and are outside of the area of influence of cold water release from Stevens Creek Reservoir. Station locations are subject to change and additional stations may be established as monitoring efforts continue and management objectives are modified.

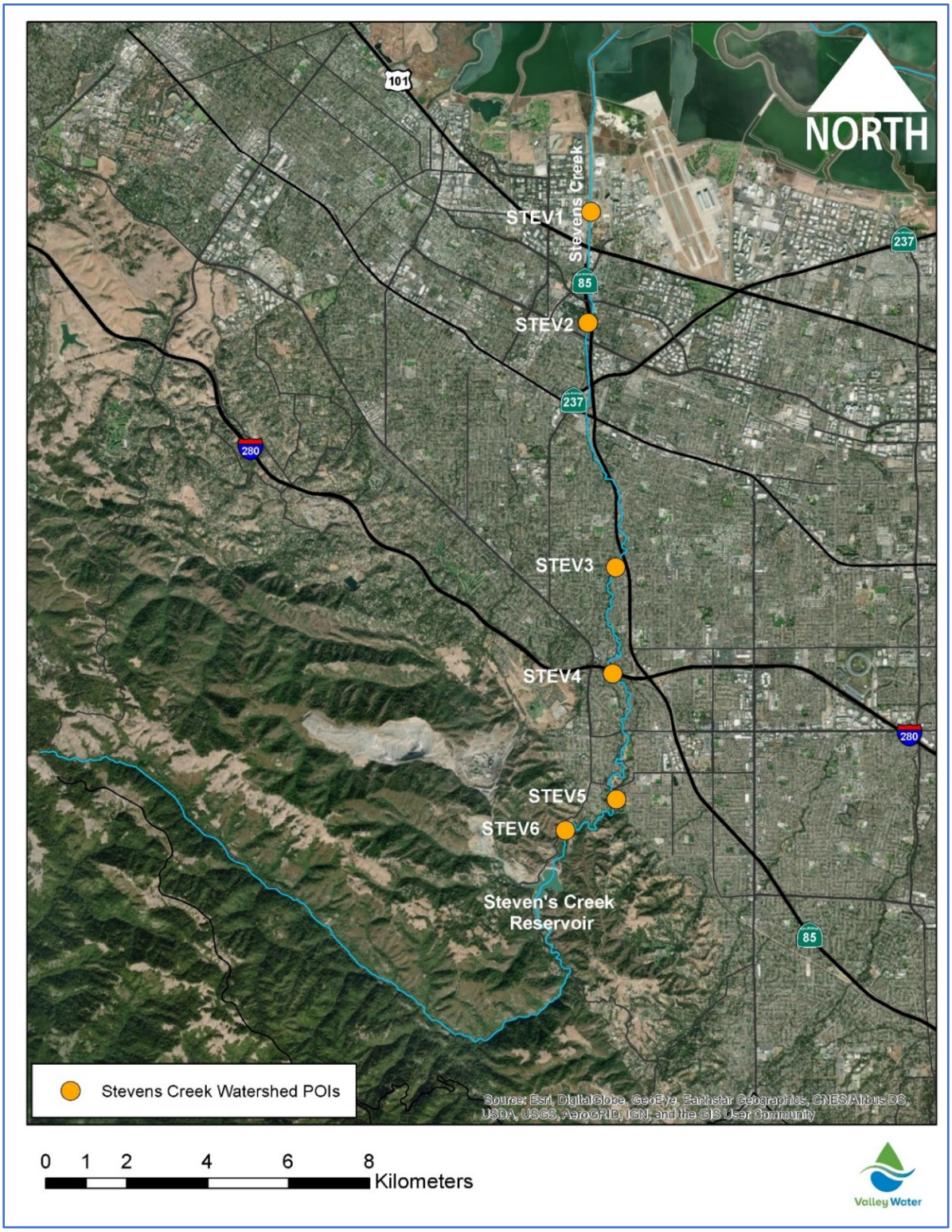


Figure 1. Stevens Creek stream temperature monitoring stations.

Temperature Loggers

Temperatures were recorded using Bluetooth-capable Onset HOBO® MX2203 Tidbit Temperature Loggers (herein referred to as logger(s)) (Figure 2). The loggers measured 4.45 x 7.32 x 3.58 cm, weighed 36.2 g, and had an accuracy of ±0.25°C with a resolution of 0.01°C. Using the Onset HOBO® mobile application from a smartphone, each logger was programmed to collect data at a 1-hour sampling rate and to start recording on the hour interval (e.g., 1:00PM, 2:00PM) following the deployment time.

Each logger was housed in an 11.5 cm x 4.3 cm galvanized steel pipe fitted with a cap at each end (Figure 3). The pipe had four 1.5 cm-diameter holes on the sides and a single hole on each of the caps to allow water to flow through the housing. In addition to providing protection and to shield the loggers from direct sunlight, the housing was also used to weigh down the logger, which helped ensure that it maintained contact with the streambed and thus remained submerged.



Figure 2. Onset HOBO® MX2203 Tidbit temperature logger.



Figure 3. Galvanized steel pipe housing for temperature loggers.

Logger Deployment

Loggers were deployed in Stevens Creek on July 23, 2020 for year-round placement thereafter. The housings (with logger inside) were attached using wire clips to a steel cable that was anchored to a stake or natural feature (e.g., tree trunk, root) along the bank of the channel. Loggers were placed in pools whenever possible to help ensure that they would stay submerged during summer low flows. One logger was deployed at each monitoring station.

Station STEV2 was dry at the time of the July deployments and a logger was not installed at this station until after Water Year 2020, which is the focus of this report. Therefore, STEV2 is not included in the following sections.

Data Download and Analysis

The temperature data was downloaded in the field onto a smartphone using the Onset HOBO® mobile application. Once downloaded, data was transferred to the internal Valley Water network and visually inspected for any erroneous temperature readings that may have resulted from either logger malfunction or the logger not being submerged in water. The loggers also had a water detection capability that recorded when the logger was “in” versus “out” of the water. This function was useful during the initial data evaluation to help differentiate between water temperature and air temperature recordings. Anomalous data was clipped from the dataset before further analysis.

Temperature data was analyzed for the time period between the deployment date (July 23, 2020) and the end of Water Year 2020 (September 30, 2020). For each monitoring station, daily averages, minimums, and maximums were calculated, as well as the 7-day moving average to smooth out daily fluctuations and highlight trends. The 7-day moving average was calculated for each day as the average stream temperature observed for the last 7 days (that day plus the 6 consecutive prior days). Maximum weekly average temperature (MWAT) was also determined for each station and computed as the maximum value of the 7-day moving average of daily mean stream temperature for the monitoring period.

The release rate from Stevens Creek Reservoir into Stevens Creek ranged from 2.5 and 6.8 cubic feet per second (cfs) during the July−September monitoring period, apart from a brief increase in flow on Sept. 9 between 10:00AM and 11:15AM when the release rate rose to 54.2 cfs (retrieved from the Valley Water Surface Water Data Portal). This information was considered when interpreting the results of the temperature data analysis.

Results

STEV1

Station STEV1 is the most downstream monitoring station located approximately 2 miles upstream of San Francisco Bay and 2,000 ft downstream of Highway 101 in the city of Mountain View. Daily mean, minimum, and maximum temperatures, along with the 7-day moving average, are shown in Figure 4. Between July and September 2020, stream temperatures ranged from 17.9 to 23.8°C with an average daily fluctuation of 2.8°C. The MWAT for station STEV1 during the monitoring period was 21.6°C.

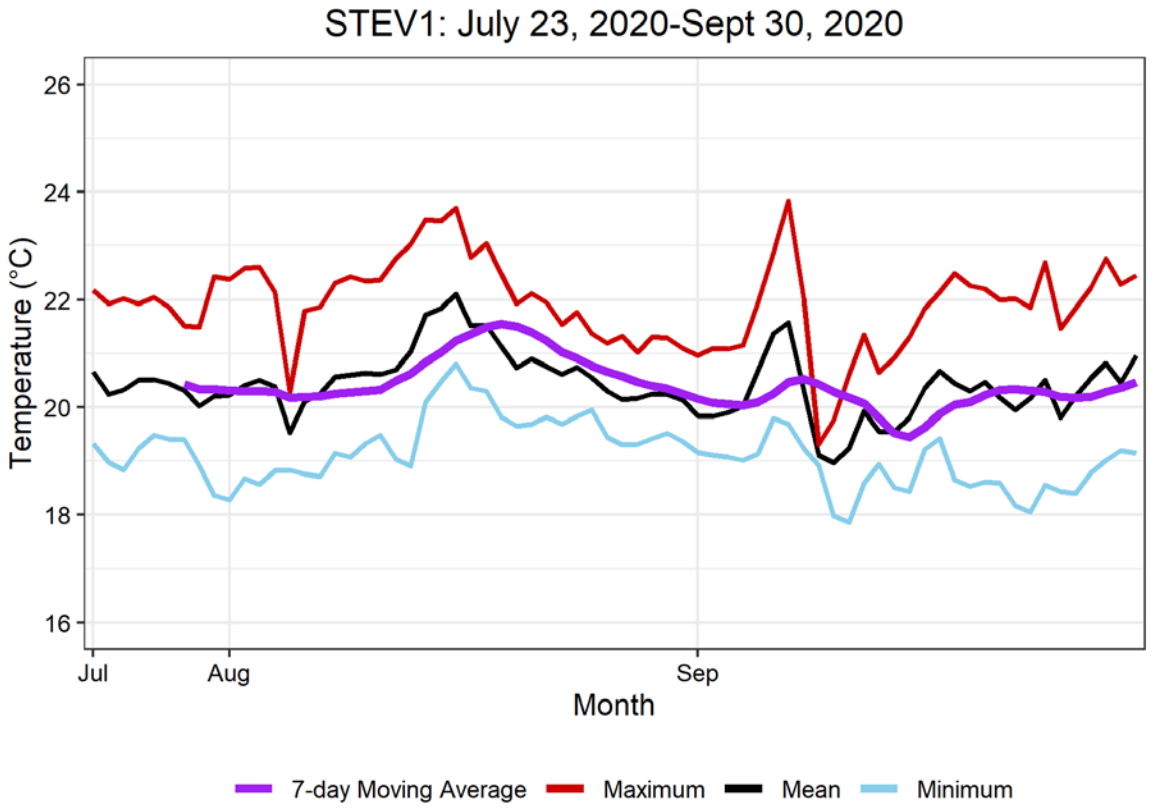


Figure 4. Daily mean, minimum, and maximum temperatures and 7-day moving average at monitoring station STEV1.

STEV3

Station STEV3 is located upstream of STEV2 at Fremont Avenue in Sunnyvale. Daily mean, minimum, and maximum temperatures, along with the 7-day moving average, for this station are shown in Figure 5. Between July and September 2020, stream temperatures ranged from 16.4 to 25.4°C with an average daily fluctuation of 2.5°C. The MWAT for station STEV3 during the monitoring period was 23.0°C.

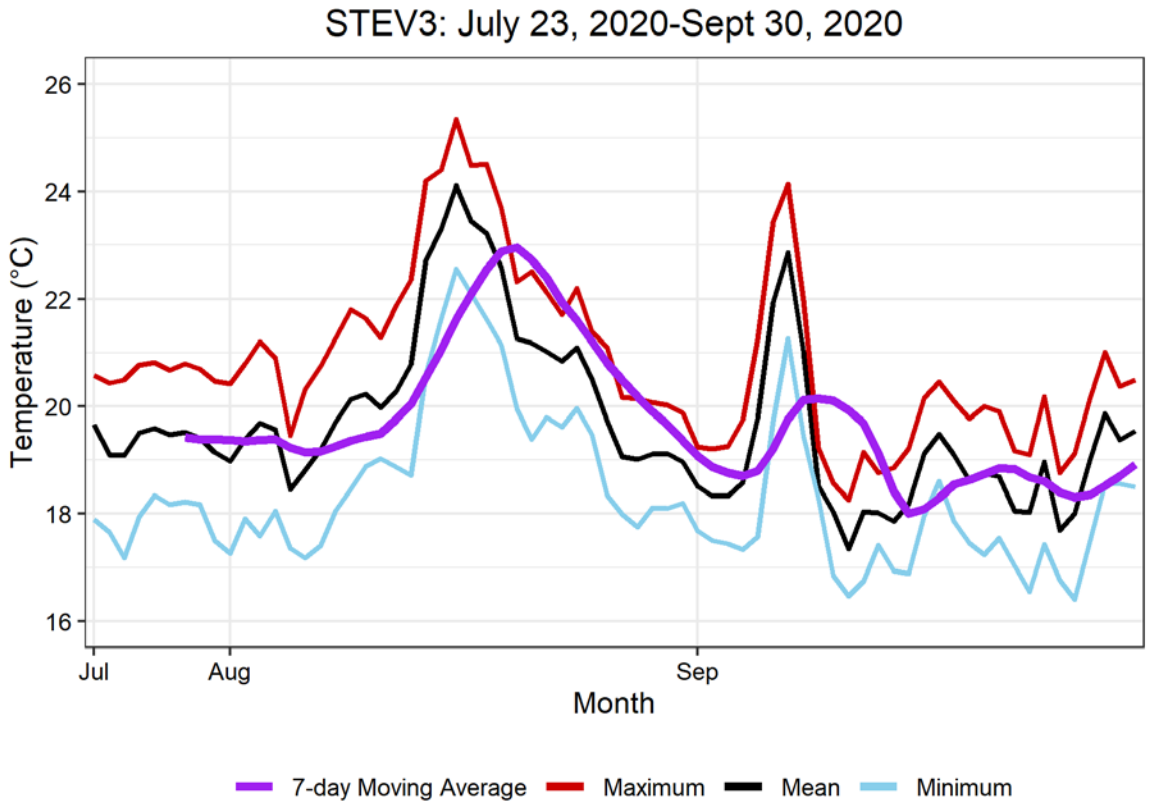


Figure 5. Daily mean, minimum, and maximum temperatures and 7-day moving average at monitoring station STEV3.

STEV4

Station STEV4 is located upstream of STEV3 and just downstream of Highway 280 in Cupertino. The station is within close proximity to Valley Water's Stevens Creek PIT antenna and is approximately 1,000 ft downstream of *O. mykiss* juvenile rearing monitoring site SC001 (see Valley Water 2021a). During initial inspection of the data, anomalously high, sporadic temperature readings were observed between Aug. 11–Sept. 22, presumably due to a dry back event that exposed the logger to the air. As a result, data between these dates was clipped from the dataset and excluded from analysis. Daily mean, minimum, and maximum temperatures, along with the 7-day moving average, for this station are shown in Figure 6. For the dates analyzed, stream

temperatures ranged from 16.4 to 21.4°C with an average daily fluctuation of 2.8°C. The MWAT for station STEV4 was 19.4°C.

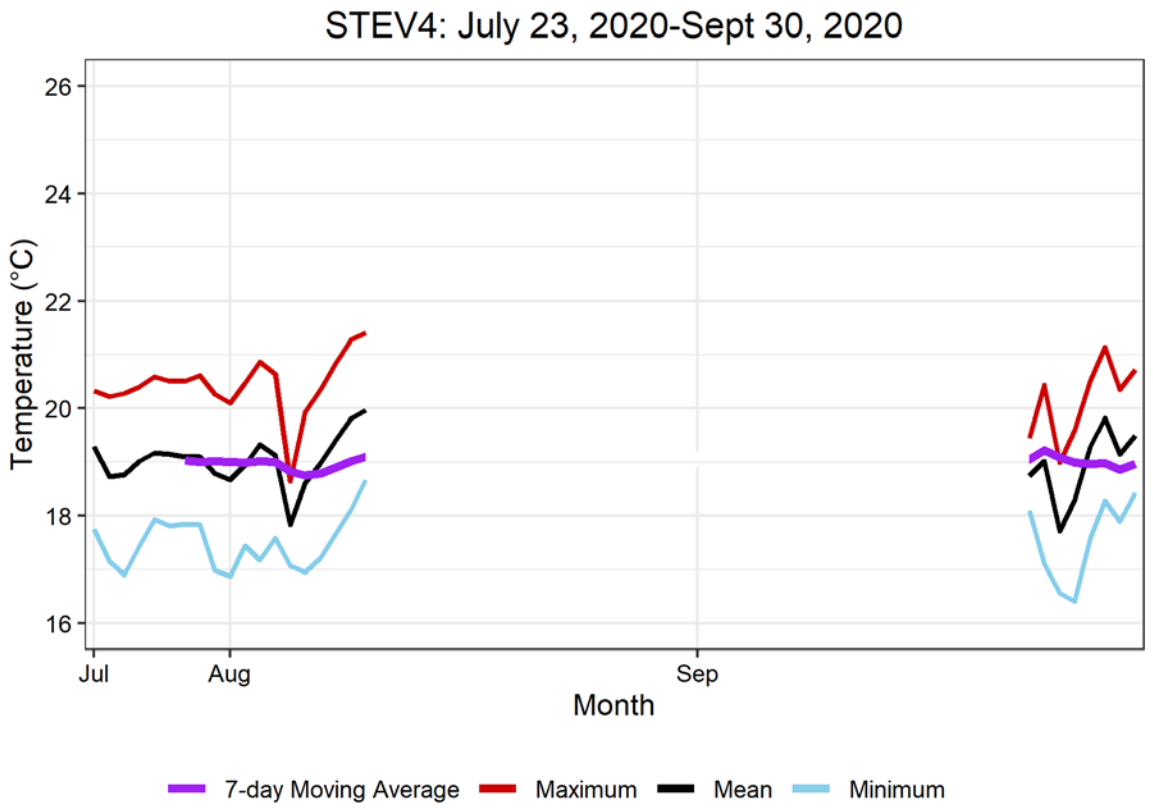


Figure 6. Daily mean, minimum, and maximum temperatures and 7-day moving average at monitoring station STEV4. Blank section indicates the time period when the logger was out of the water and temperature recordings were omitted.

STEV5

Station STEV5 is located upstream of STEV4 and just downstream of McClellan Road in Cupertino. The station is positioned within the *O. mykiss* juvenile rearing monitoring reach, SC004 (see Valley Water 2021a). Daily mean, minimum, and maximum temperatures, along with the 7-day moving average, for this station are shown in Figure 7. Between July and September 2020, stream temperatures ranged from 16.8 to 24.0°C

with an average daily fluctuation of 2.9°C. The MWAT for station STEV5 during the monitoring period was 21.5°C.

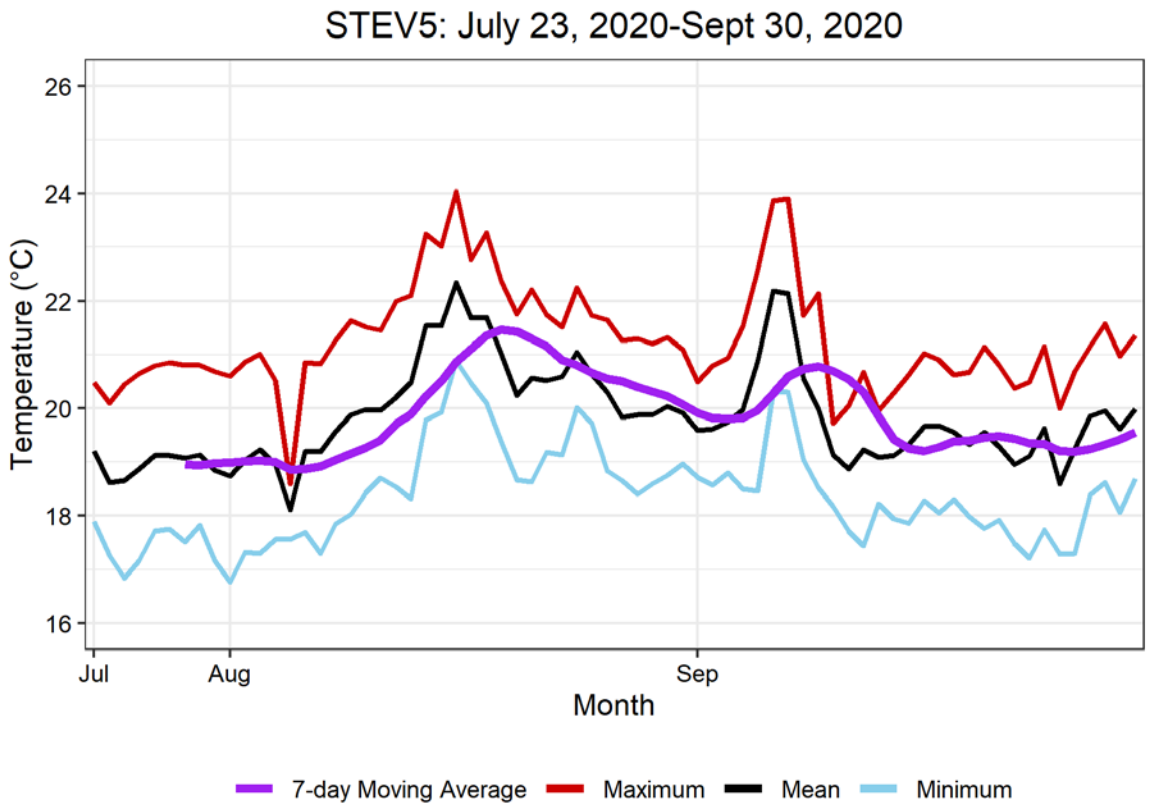


Figure 7. Daily mean, minimum, and maximum temperatures and 7-day moving average at monitoring station STEV5.

STEV6

Station STEV6 is the most upstream monitoring station located approximately 2,000 ft downstream of the Stevens Creek Reservoir outlet. The station is situated about midway between *O. mykiss* juvenile rearing sites SC005 and SC006 (see Valley Water 2021a) and a little over 1,000 ft from each. Daily mean, minimum, and maximum temperatures, along with the 7-day moving average, for this station are shown in Figure 8. Between July and September 2020, stream temperatures ranged from 18.3 to 24.2°C with an average daily fluctuation of 2.0°C. The MWAT for station STEV6 during the monitoring period was 22.4°C.

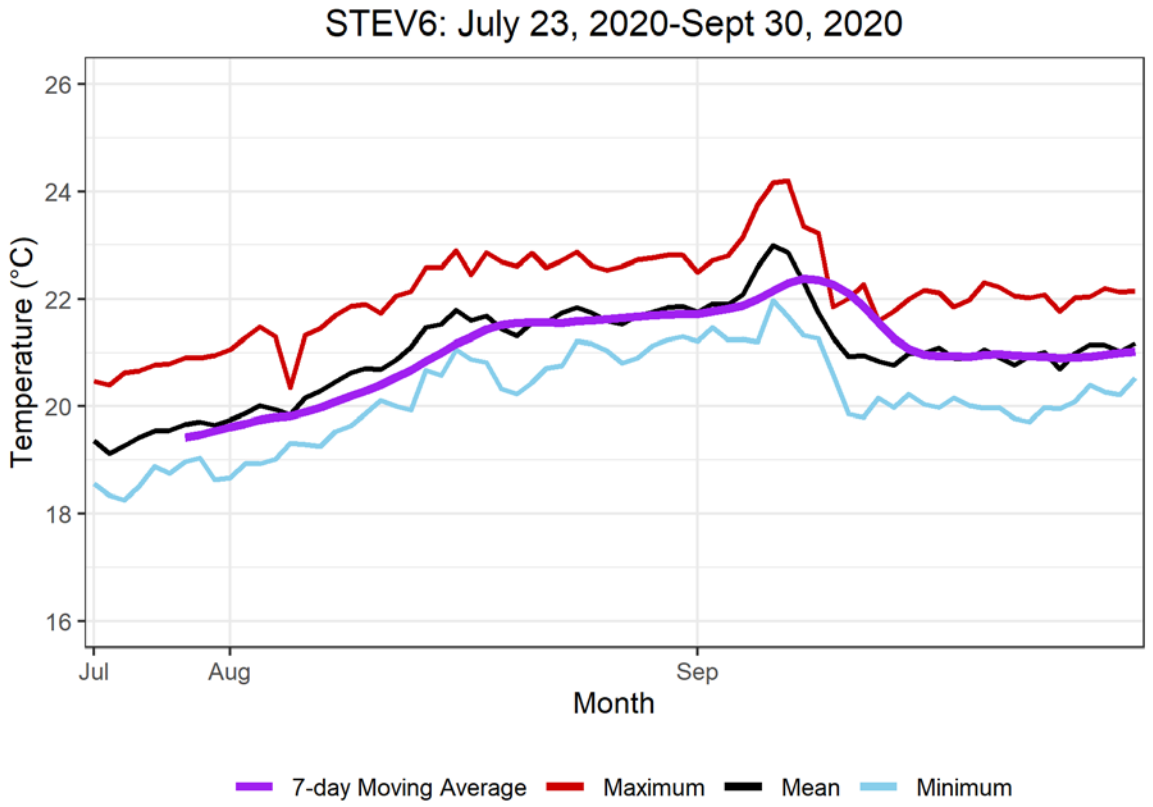


Figure 8. Daily mean, minimum, and maximum temperatures and 7-day moving average at monitoring station STEV6.

Discussion

All stations showed a similar trend where temperatures increased until the middle of August, decreased up to the beginning of September, then spiked before leveling off for the remainder of the Water Year. Aside from the spike in September, this temperature trend is fairly typical for the region. With the exception of STEV6, all stations had two distinct peaks in temperature in the middle of August and between Sept. 5−8, which coincide with the dates of the extreme heat waves that occurred in the Bay Area and throughout the state of California. Record-breaking air temperatures during the heat waves help explain why stream temperatures also rose during those time-frames.

There were no apparent temperature patterns along the length of Stevens Creek as overall ranges and average daily fluctuations were similar among stations. STEV6 (most

upstream), however, showed lower daily variation than the other stations and less dramatic spikes and dips in temperature. These results are to be expected due to its proximity to the outlet of Stevens Creek Reservoir. Stevens Creek Reservoir is a bottom release reservoir, and as a result of the thermal buffering caused by the reservoir pool, releases water that is more consistent in temperature. Notably, STEV3 had the most dramatic increases in temperature. The reason for this is uncertain, but it is possible that streamflow was lower at STEV3 relative to other stations or that the logger was placed in a comparatively shallower pool.

Data for Water Year 2020 was limited since temperature monitoring under FAHCE did not begin in Stevens Creek until July. Furthermore, the data that we were able to collect was only in the summer when stream temperatures were relatively high because they coincided with low stream flows and warm daytime temperatures. Now that the loggers are deployed and collecting continuous data, we will have year-round temperatures to assess for future Water Years that show seasonal variations and encompass all *O. mykiss* life stages.

Stevens Creek supported multiple *O. mykiss* age classes and summer rearing was successful based on the results of Valley Water's juvenile rearing monitoring effort (Valley Water 2021a). Across the 6 juvenile rearing sites sampled during the effort, a total of 47 *O. mykiss* were collected. The majority of individuals were young-of-the-year in healthy condition with high relative weights (Valley Water 2021b) and no evidence of blackspot disease or other maladies (Valley Water 2021a). Stevens Creek is thus capable of supporting the rearing and persistence of juvenile *O. mykiss*. Continuing to monitor stream temperatures in conjunction with juvenile rearing sampling and other fisheries monitoring efforts will be useful towards furthering our understanding of *O. mykiss* in Stevens Creek and informing management objectives.

References

Valley Water. 2021a. 2020 Juvenile *Oncorhynchus mykiss* Rearing Monitoring in Stevens Creek.

Valley Water. 2021b. 2020 Stevens Creek Juvenile *O. mykiss* Fish Condition.

2020 Stevens Creek
Juvenile *Oncorhynchus mykiss* Fish Condition

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February 2021

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Appendices

Appendix A: Individual Measurements, Standard Weights (W_s), and Relative Weights (W_r) of *O. mykiss* Sampled During Fall 2020 Stevens Creek Juvenile Rearing Monitoring

Background

Fish condition is a measure of length and weight that represents the physiological or nutritional state of a fish and can be used to compare the effects of biotic and abiotic factors on the health of a population (Murphy et al. 1990, Cone 1989). For instance, the presence of generally plump fish may be indicative of favorable environmental conditions (high-quality habitat, ample prey availability, etc.), whereas thin fish may indicate less favorable conditions. Therefore, monitoring fish condition can be useful for informing management recommendations concerning fish populations.

Relationships between weight and length are often used for assessing population size structure and individual fish condition. Because fish weight is directly related to fish length, weight-length data is not only used to predict one from the other, but it can also be used as an indicator of an individual's fatness or condition by measuring the variation from the expected weight for a certain length (LeCren 1951). The traditional approach to assessing fish condition involves the use of a 'condition factor,' which employs a fixed ratio to describe the relationship between fish length and weight (Murphy et al. 1991). The commonly used Fulton's condition factor (K) (Fulton 1904) is calculated as:

$$K = W / L^3$$

Where W is weight and L is length. Though it has the advantage of being easy to calculate, Fulton's condition factor has its drawbacks. First, it assumes isometric growth (power = 3, fish shape does not change with growth), which is rarely the case for most fish species (Froese 2006). Second, it is highly length- and species-dependent; therefore, it can only be reliably used to compare individuals with similar lengths and is practically impossible to compare across species. LeCren (1951) developed the relative condition factor (K_n) to address these issues, which is calculated with the formula:

$$K_n = W / W' \times 100$$

Where W is the actual weight of the individual fish and W' is the predicted length-specific mean weight for the population under study. While this approach solved the

problem of comparing fish of different lengths and species, it is population-dependent and thus cannot be used to compare fish condition across populations.

The concept of ‘relative weight’ as a condition index was first introduced by Wege and Anderson (1978) for measuring the condition of largemouth bass (*Micropterus salmoides*). The relative weight approach compares fish weight to a benchmark, or standard weight, of that species based on weight-length data collected throughout its range. Wege and Anderson believed that relative weight had several advantages over other condition factors: 1) it is easy to calculate, 2) relative weight does not change with different units of measure, 3) standard weights compensate for inherent changes in body form, and 4) relative weight values can be compared between fish of different lengths and from different populations (Blackwell et al. 2000). For these reasons, the relative weight index has become widely used in recent years as a measure of fish condition.

Introduction

Stevens Creek consists of approximately 32 kilometers of channel and originates in the Monte Bello Open Space Preserve in the Santa Cruz Mountains. The western portion of the watershed where Stevens Creek originates remains relatively free of anthropogenic disturbance. The creek flows southeasterly through the Stevens Creek County Park before entering Stevens Creek Reservoir, then continues north and empties into the San Francisco Bay at Whisman Slough next to Mountain View’s Shoreline Park. The eastern and northern potions of Stevens Creek flow across the Santa Clara County Valley floor, traversing mainly urbanized areas with patches of undeveloped park land. Stevens Creek drains a watershed of roughly 75 square kilometers.

Stevens Creek supports the federally threatened Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*) Distinct Population Segment (DPS) and is designated critical habitat from the creek’s confluence with the San Francisco Bay to Stevens Creek Reservoir (70 FR 52570, September 2005). To better understand the health of juvenile *O. mykiss* in Stevens Creek, fish condition was analyzed for *O. mykiss*

sampled during Valley Water's 2020 juvenile rearing monitoring season. The relative weight approach was used to evaluate fish condition due to the utility and ease with which it can be calculated and analyzed.

Methods

Data Collection

In fall 2020, length-weight data was collected from juvenile *O. mykiss* sampled during Valley Water's Stevens Creek index reach monitoring effort. The purpose of this annual monitoring effort, which began in Stevens Creek in 2020, is to document the abundance, distribution, and densities of *O. mykiss*. For details on data collection methods, including sampling sites and fish processing procedures, please refer to the 2020 Juvenile *O. mykiss* Rearing Monitoring in Stevens Creek report (Valley Water 2021).

Calculations

The standard weight for each fish was calculated from their measured length using the following standard weight equation developed for juvenile *O. mykiss* ranging from 50 to 200 mm fork-length (Duffy 2006):

$$\log_{10} W_s = -4.790 + 2.928 \log_{10} FL$$

Where W_s is the standard weight in grams and FL is the fork-length in millimeters. This standard weight equation was developed using weight-length data from 121 *O. mykiss* populations ranging from southern Alaska through central California (Duffy 2006), including populations within the CCC DPS. The equation was formed using the regression-line-percentile technique (Murphy et al. 1990), which is based on 75th-percentile weights and uses $\log_{10}$ transformed data from a series of populations as the statistical population to be modeled (Blackwell et al. 2000).

The slope of the standard weight equation (b = 2.928) developed by Duffy (2006) indicates that juvenile *O. mykiss* ranging from Alaska to central California exhibit slight negative allometric growth (they become more elongated as they grow, $b < 3$), which

defies the assumption of Fulton's condition factor of $b = 3$. In contrast, when $b > 3$, a fish experiences positive allometric growth and increases more in weight than predicted by its increase in length (it becomes more rounded as it grows) (Froese et al. 2011).

Standard weight was then used to calculate relative weight of individuals with the equation:

$$W_r = (W / W_s) \times 100$$

Where W_r is the relative weight and W is the weight of the fish being compared in grams. The factor 100 is used to express the equation as a percentage of W_s. Note that once $\log_{10}W_s$ was determined for each fish using the standard weight equation, the antilog of these values was used in the above equation to calculate W_r.

Lastly, individuals were categorized into 25-mm fork-length classes (hereafter referred to as length classes) in order to analyze for any length-related condition trends in the population sampled (Blackwell et al. 2000). The Kruskal-Wallis test was used to determine if there were statistically significant differences in W_r between length classes ($p < 0.05$). Considered the nonparametric alternative to the one-way ANOVA, the Kruskal-Wallis test was used for this study due to the non-normal data distributions and small sample sizes.

Relative Weight Target Range

The regression-line-percentile technique used to develop the standard weight equation above uses 75th-percentile weights; therefore, a W_r value of 100 (the actual weight of the fish equals the standard weight) is not an average-sized fish. Rather, it means that across their range, 25% of the juvenile *O. mykiss* will have a W_r value greater than 100 while 75% will be less than 100. A fish with a W_r of 100 is thus considered to be in better-than-average condition. For the original development of the W_r index (Wege and Anderson 1978), 75th-percentile weights were also used as a standard. Anderson (1980) subsequently recommended that 95−105 be used as a W_r target range in order to aim for fish populations that are in above average condition, and it has since been widely used by fisheries managers.

Nonetheless, Murphy et al. (1991) cautioned against using a universal target range for optimal condition, believing that “optimal” will vary according to specific management objectives and environmental limitations. Targets for W_r should therefore be established according to the management goals for a given program, but further research is needed to evaluate appropriate W_r target ranges for juvenile *O. mykiss* populations under various management scenarios.

For the purposes of this report, the W_r target range of 95−105 (Anderson 1980) was used to define fish in optimal condition. This W_r target range may be modified in the future as more data is collected and as management objectives for Stevens Creek become established.

Results

Forty-seven *O. mykiss* were sampled during the 2020 Stevens Creek juvenile rearing monitoring season. Measured weights ranged from 2.1 to 48.5 g with a mean weight of 8.09 g (SD=9.54). Measured fork-lengths ranged between 56 and 162 mm with a mean fork-length of 78.4 mm (SD=23.9).

Relative weight of the sampled population ranged from 91.6 to 133.4 with a mean W_r of 110.8 (SD=10.2) (Figure 1). Of the 47 *O. mykiss* sampled, 13 individuals fell within the 95−105 optimal range (28% of sampled fish), three fish were below 95 (6% of sampled fish), and thirty-one fish were above 105 (66% of sampled fish).

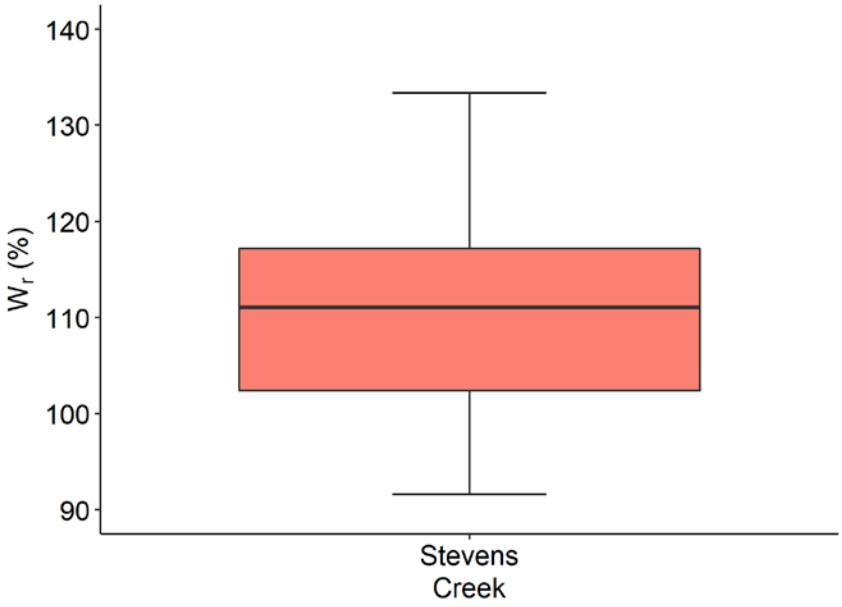


Figure 1. Boxplot (with the median, 25% and 75% quartiles, and whiskers extending 1.5 times the interquartile ranges) of juvenile *O. mykiss* relative weights (W_r) of all individuals sampled in Stevens Creek (n = 47).

Relative weight plotted as a function of fork-length revealed no apparent length-related trends in condition, and fork-length had no effect on W_r based on a linear regression analysis (adjusted R^2 = -0.002, 95% CI [-0.19, 0.07], p = 0.352) (Figure 2). Summary statistics for W_r per 25-mm length class are provided in Table 1 and distributions are shown in Figure 3. There were no statistically significant differences in mean W_r among length classes as determined by a Kruskal-Wallis test (H = 5.40, df = 4, p = 0.249).

Individual fish measurements, W_s, and W_r are provided in Appendix A.

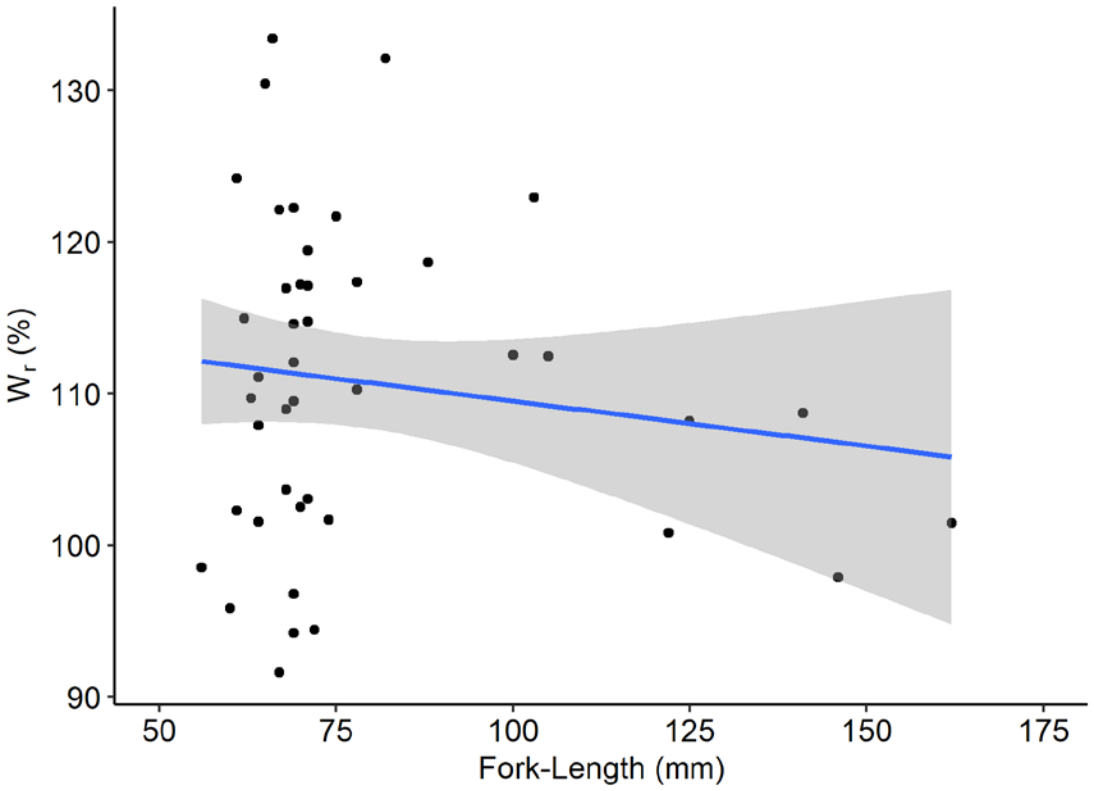


Figure 2. Relative weight (W_r) as a function of fork-length for juvenile *O. mykiss* sampled in Stevens Creek. Regression line in blue with confidence bands in gray.

Table 1. Summary statistics of Stevens Creek juvenile *O. mykiss* relative weights (W_r) per 25-mm length class. Means are presented as the value ± SD. Sample size = n.

Length Class (mm)	**n**	**Mean W_r (%)**	**W_r Range (%)**
51-75	35	110.38 ± 10.49	91.57−133.39
76-100	5	118.17 ± 8.50	110.24−132.08
101-125	4	111.07 ± 9.24	100.78−122.90
126-150	2	103.27 ± 7.65	97.86−108.68
151-175	1	101.46	101.46

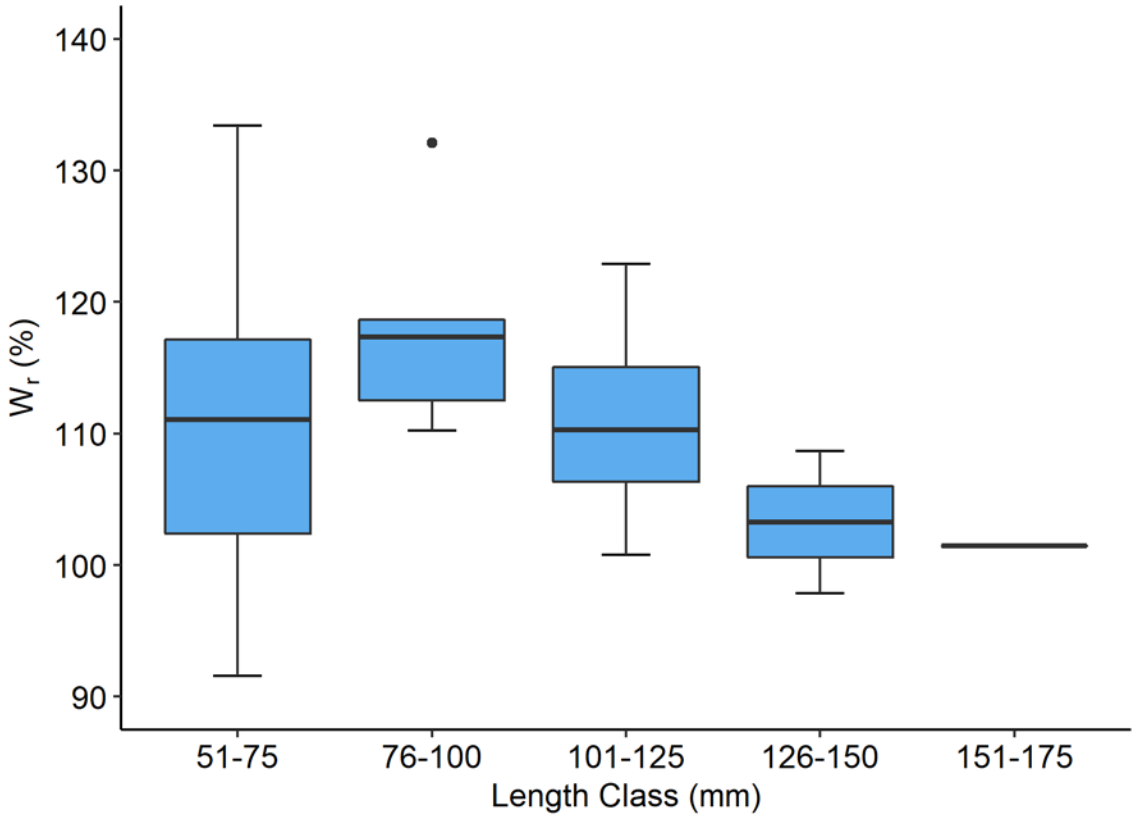


Figure 3. Boxplots (with the median, 25% and 75% quartiles, whiskers extending 1.5 times the interquartile ranges, and outlying points beyond whiskers) representing Stevens Creek juvenile *O. mykiss* relative weights (W_r) per 25-mm length class.

Discussion

Our results show that there were no significant differences in W_r among length classes and that length was not correlated to W_r. This suggests that juvenile *O. mykiss* condition in Stevens Creek does not differ substantially between fish of varying lengths/ages. Though not statistically significant, the 76 to 100 mm length class had the highest mean relative weight, but it should be noted that there were large discrepancies in sample size among length classes and 74% (n=35) of the sampled population fell within the 51 to 75 mm category. As more data is collected, any length-related trends in fish condition will become more apparent.

Relative weights of juvenile *O. mykiss* in Stevens Creek ranged widely, but values indicate that the vast majority of fish are in excellent condition with 94% of the sampled

population falling either within or above the optimal W_r target range (95−105). Fish with a high W_r can signify a waterbody with conditions ideal for growth, such as suitable habitat and water quality and abundant prey (Murphy et al. 1990, Liao et al. 1995). Presence of physical habitat features like large woody debris and undercut banks can contribute to improved juvenile *O. mykiss* condition and survival by providing refugia from predators and high flow velocities. Water temperature can likewise influence fish condition and has been documented to impact growth and size of *O. mykiss* and other salmonids through effects on metabolism, behavior, and mortality (Bjornn and Reiser 1991). Young of the year *O. mykiss* fed to satiation exhibited increased growth rates at increased temperatures (up to 19º C) in a laboratory setting (Myrick and Cech 2005), and increased fall-spring temperatures (maximum temperature was approximately 11º C) were also shown to result in increased growth in *O. mykiss* (Railsback and Rose 1999). However, at extreme upper temperatures, growth may be reduced (Bjornn and Reiser 1991). According to NFMS (2016), optimal water temperatures for juvenile *O. mykiss* growth range from 12 to 19°C (~54 to 66°F), though the majority of research done on suitable temperatures for salmonids has been conducted in the Pacific Northwest where environmental conditions are much different than the Central California Coast. Earlier studies have also found relationships between W_r and food supply (Flickinger and Bulow 1993, Liao et al. 1995) and shown that prey biomass is positively correlated with fish condition.

Our high W_r results suggest that environmental conditions in Stevens Creek are favorable for juvenile *O. mykiss.* Stevens Creek is known to have habitat complexity in the form of large woody debris, boulders, rootwads, undercut banks, and emergent vegetation (Valley Water 2021), and stream temperatures in this region are within the range defined by NMFS (2016) for most of the year (excluding summer). Though no studies on *O. mykiss* prey abundance have been conducted in Stevens Creek, our high W_r results imply that adequately-sized prey items are readily available.

Additionally, previous studies on salmonids have shown that fish weight or growth is inversely related to population density (Close and Anderson 1992, Keeley 2003), and that mean population W_r values are higher in areas where low densities of fish occur

(Johnson et al. 1992). This is because individual fish weight and condition are likely to improve when there is reduced competition for food and other resources. During fall 2020 sampling, the estimated *O. mykiss* population density in Stevens Creek was fairly low at 0.3 *O*. *mykiss*/meter (Valley Water 2021) and may be a contributing factor to high W_r in the system. More reliable conclusions regarding the influence of density on fish condition can be made as sampling continues.

It is worth noting that human error has the potential to skew the results. Accurately measuring the length and weight of fish can be difficult in the field, especially with small fish and when they need to be measured quickly. Furthermore, issues taring the scale in the field and excess water on the equipment (scale and measuring board) can affect the weight measurement.

Although the majority of individuals had a considerably high W_r, the results are within reason when compared to other populations of juvenile *O. mykiss* from Alaska through northern California. McLaughlin (2009) calculated the average W_r for over 100 juvenile *O. mykiss* populations of various size throughout northern California, Oregon, Washington, and Alaska. Average W_r for populations in McLaughlin's dataset ranged from 78.2 to 118.1 with an average of 97.7. The sampled population in Stevens Creek had an average W_r of 110.8, and thus falls within the aforementioned range.

As previously stated, results are limited at this time because 2020 was the first year of sampling in Stevens Creek. Interannual comparisons will become possible with continued juvenile *O. mykiss* rearing sampling, and any climatic variation (e.g., dry, warm years vs. wet, cold years) and operational changes (e.g., flow releases or reductions) can be incorporated into the results to determine if there is any correlation between these factors and fish condition. Due to the advantage of using W_r as a condition index, future comparisons can also be made between Stevens Creek and other *O. mykiss* populations in Santa Clara County.

Juvenile *O. mykiss* sampled in Stevens Creek in 2020 were overall in healthy condition, indicating that environmental conditions within the system are favorable for supporting the growth and persistence of juvenile *O. mykiss*.

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Appendix A

Individual Measurements, Standard Weights (W_s), and Relative Weights (W_r) of *O. mykiss* Sampled During Fall 2020 Stevens Creek Watershed Juvenile Rearing Monitoring

FishID	Weight (g)	Fork-Length (mm)	W_s (g)	W_r (%)	Site
2020STV001	2.5	60	2.61	95.83	SC006
2020STV002	48.5	162	47.80	101.46	SC006
2020STV003	15.1	105	13.43	112.44	SC006
2020STV004	2.1	56	2.13	98.52	SC006
2020STV005	21	122	20.84	100.78	SC005
2020STV006	15.6	103	12.69	122.90	SC005
2020STV007	2.8	61	2.74	102.26	SC005
2020STV008	24.2	125	22.37	108.16	SC005
2020STV009	4.8	70	4.10	117.16	SC005
2020STV010	34.5	146	35.26	97.86	SC004
2020STV011	4.4	68	3.76	116.91	SC004
2020STV012	3.3	63	3.01	109.66	SC004
2020STV013	4.5	69	3.93	114.57	SC004
2020STV014	4.3	69	3.93	109.48	SC004
2020STV015	3.3	62	2.87	114.92	SC004
2020STV016	3.8	69	3.93	96.75	SC004
2020STV017	13.1	100	11.64	112.53	SC003
2020STV018	4.3	65	3.30	130.39	SC003
2020STV019	34.6	141	31.84	108.68	SC003
2020STV020	4.2	72	4.45	94.40	SC003
2020STV021	8.6	82	6.51	132.08	SC003
2020STV022	9.5	88	8.01	118.65	SC003
2020STV023	3.7	69	3.93	94.20	SC003
2020STV024	4.6	66	3.45	133.39	SC003
2020STV025	3.3	67	3.60	91.57	SC003
2020STV026	4.1	68	3.76	108.94	SC003
2020STV027	4.8	69	3.93	122.21	SC003
2020STV028	3.9	68	3.76	103.63	SC003
2020STV029	4.9	71	4.27	114.74	SC002
2020STV030	4.2	70	4.10	102.52	SC002
2020STV031	4.4	67	3.60	122.10	SC002
2020STV032	3.5	64	3.15	111.06	SC002
2020STV033	4.8	70	4.10	117.16	SC002
2020STV034	3.4	64	3.15	107.89	SC002
2020STV035	4.4	71	4.27	103.03	SC002

2020STV036	5	71	4.27	117.08	SC002
2020STV037	6.1	75	5.01	121.66	SC002
2020STV038	4.4	71	4.27	103.03	SC002
2020STV039	3.4	61	2.74	124.17	SC002
2020STV040	4.5	69	3.93	114.57	SC002
2020STV041	4.4	69	3.93	112.02	SC002
2020STV042	6.6	78	5.62	117.35	SC002
2020STV043	3.3	62	2.87	114.92	SC002
2020STV044	6.2	78	5.62	110.24	SC002
2020STV045	3.2	64	3.15	101.54	SC001
2020STV046	5.1	71	4.27	119.42	SC001
2020STV047	4.9	74	4.82	101.64	SC001